Gallstone Disease

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The presence of gallstones is quite common in the Western World and increases with age and gender, being more present in women. The prevalence in the Western World ranges from 10– 60% in females aged 30–60 years old. The prevalence in men is approximately 40%. Incidence and prevalence in developing countries are less well known but considered relatively uncommon. It is estimated that each year, up to 5% of gallstones carriers become symptomatic and present with either a biliary colic, acute cholecystitis and less common with acute cholangitis or pancreatitis.

The gallbladder functions to store bile. It is filled passively in a retrograde manner. When a meal is consumed and the Sphincter of Oddi relaxes, it will empty by 50–70% in the next 1–2 h to be mixed with the enteric contents.

Gallstones are formed as the hyper-saturated bile fails to remain in a soluble state and crystals form. Admirand's triangle is the most often quoted model for this process where the components leading to crystal formation (cholesterol and bile pigments) are in imbalance with the dissolvent (lecithin). Contributing factors include the ability of the gallbladder to extract water from the stored bile and gallbladder dysmotility that leads to stasis and further concentration of bile salts and pigments.

Any condition influencing the above will lead to an increased risk of gallstone formation. For example, haemolytic disorders leading to increased bile pigment production, rapid weight loss leading to increased cholesterol excretion or prolonged gallbladder dysmotility and biliary stasis in critically ill or malnourished patients. Females are at an increased risk due to the fluxes of oestrogen and progesterone. This leads to altered cholesterol metabolism and increased dysmotility.

Although pure cholesterol or bile pigment stones exist, the majority are mixed. Only 15% contain enough calcium to be radiopaque.

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F. Piscioneri et al. (eds.), *Emergency Surgery for Low Resource Regions*,
Hot Topics in Acute Care Surgery and Trauma,
https://doi.org/10.1007/978-3-030-68099-2_10

The complaints caused by gallstones are all mechanical in nature and caused by a blockage somewhere within the biliary system. If the stone is lodged at Hartmann's pouch or within the cystic duct the gallbladder can no longer empty itself and a biliary colic will occur. If the obstruction persists acute cholecystitis may occur; initially as a biochemical response, but culminating in an infection owing to the stasis of bile.

The distal common bile duct (CBD) is another point of obstruction. This results in post-hepatic (obstructive) jaundice. Cholangitis develops along the continuum described above.

The ampulla serves as the final point of obstruction in the biliary system. This is a point of confluence of the CBD and pancreatic duct before it empties into the duodenum. The obstruction of the pancreatic duct can lead to pancreatitis as well as obstruction of the CBD thus leading to obstructive jaundice and cholangitis. However, as the stones are smaller in calibre and often pushed through into the duodenum by the increased biliary pressure, the biliary obstruction is mostly transient in nature and only the (biliary) pancreatitis remains.

10.1 History and Examination

Right upper quadrant pain radiating to the tip of the right shoulder blade is a typical presenting problem. The pain is continuous in nature but it escalates in waves. To some it is comparable to labour of pregnancy. A biliary colic should settle within a few hours, but if it persists for longer it would be more in keeping with acute cholecystitis. Attention should also be paid to the presence of febrile episodes, pruritis, discoloured stools and darkened urine as a sign of CBD obstruction.

On examination, one should be conscious of identifying jaundice (e.g. scleral icterus and scratch marks) on general inspection. Further to this, pain on palpation of the right upper quadrant with guarding is considered typical for acute cholecystitis. The diagnosis is reaffirmed with Murphy's sign. However, it should be noted that clinical examination performs poorly in distinguishing biliary colic from acute cholecystitis.

In the elderly, it is prudent to exclude other differential diagnoses of right upper quadrant pain (e.g. myocardial ischemia, lower lobe pneumonia, Varicella Zoster rash).

10.2 Investigations

Elevated white cell count and C-reactive protein may support the diagnosis of an underlying inflammatory process (acute cholecystitis, cholangitis, or pancreatitis), but is not present in 20% of cases. A liver function panel including lipase should help in separating the differential diagnosis in which the pattern of biliary obstruction (bilirubin), liver cell damage (AST, ALT) and/or biliary endothelium injury

(GGT, ALP) can aid in confirming a diagnosis. Bedside and biochemical investigations discussed in the acute abdomen chapter should be considered here.

Ultrasound imaging is considered the gold standard for confirming the presence of gallbladder stones with an estimated sensitivity and specificity of over 95%. However, often due to gas in the overlying duodenum, the bile duct is less accessible for assessment. As most stones do not contain enough calcium, they may not be radiopaque to be seen on plain abdominal films or CT scan. An MRI/MRCP is highly sensitive in diagnosing cholelithiasis in both gallbladder and bile ducts, but due to its cost and reduced availability it is not the first choice in imaging. Ultrasound is less reliable in diagnosing acute cholecystitis. Historically, oral cholecystogram has been used to diagnose gallstones.

10.3 Differential Diagnosis

All diseases or conditions of the organs in the right upper quadrant may present in a nearly similar manner and only by combining history, examinations, and investigations can a proper diagnosis be made. As gallstones are endemic their presence should not blind the clinician in ignoring alternative diagnosis. A differential diagnosis should consist of but not limited to:

- Biliary colic
- Acute cholecystitis
- Acute cholangitis
- Hepatitis
- Pancreatitis
- Gastritis
- Gastric or duodenal ulcer disease
- Pyelonephritis
- Cardiac pathology
- Pulmonary pathology

10.4 Treatment Options

10.4.1 Medication

Except for antibiotics and analgesia, no recognised medical treatment to treat cholelithiasis or cholecystitis exist.

10.4.2 Intervention Radiology

Ultrasound or CT guided percutaneous transhepatic cholecystostomy drainage is an alternative to cholecystectomy. Its use is preferred in those unfit for surgery. The

drain should pass through the liver partially as the parenchyma will help collapse the drain tract after drain removal and prevent persistent leakage. A cholangiogram through the drain before removal is advisable as a persistent lodged gallstone in Hartmann's pouch or cystic duct may lead to reaccumulating fluid within the gallbladder with a risk of recurrent cholecystitis. Only when a patent cystic duct draining into the common bile duct and duodenum is seen, can the drain be removed with absolute safety and certainty.

10.4.3 Intervention Endoscopy

An Endoscopic Retrograde Cholangio-Pancreaticography (ERCP) is not only diagnostic but also therapeutic. It serves as a means of extracting CBD calculi.

Where possible and available, in the presence of choledocholithiasis, ERCP should be undertaken prior to cholecystectomy. This allows CBD exploration to be performed in conjunction with the cholecystectomy if ERCP were to be unsuccessful.

In low resourced regions, it is likely ERCP is not as accessible and therefore an open or laparoscopic CBD exploration should be within the scope of the treating surgeon.

10.4.4 Surgery

Surgery is the definitive treatment for symptomatic cholelithiasis. The preferred option will depend on the surgeon's capabilities, the available resources and additional support by an endoscopy service or intervention radiology as well as the patient's suitability as determined by co-morbidities and previous abdominal surgery.

The most common approach would be by laparoscopy, with an umbilical port placed for the camera. Further ports placed in the epigastrium and two in the right flank provide manoeuvrability and retraction capability for the surgeon and assistant, respectively.

Alternatively, an open approach by a subcostal or midline incision can be used. A wound retraction system or fixed body wall retractor has merits but a second assistant is equally valuable. In an open approach it is wise to pack the liver posterolaterally to present the gallbladder anteriorly.

In a laparoscopic cholecystectomy, an antegrade dissection is preferred. The principles include identification of Rouvier's sulcus and segment 4b, dividing the peritoneum from Hartmann's pouch up towards the fundus, exposing Calot's triangle, identifying Strasberg's critical view of safety (CVS), consider the value of a cholangiogram, ligation of cystic duct and artery, dissection and retrieval of the gallbladder whilst aiming to abstain from spilling stones.

If a CVS cannot be obtained owing to severe inflammation or fibrosis a retrograde approach might be considered along with a subtotal resection and possibly conversion to open.

In a retrograde dissection, care should be taken to stay on the posterior wall of the gallbladder. When the gallbladder starts to separate from the liver is often a sign the surgeon is approaching the hilum and proceed further with caution.

If the hilum is too adherent to the ligament and anatomy cannot be defined with absolute certainty a subtotal cholecystectomy should be considered. Despite oversewing the remaining gallbladder stump it often leads to a post-operative bile leak, which will settle in time with the aid of a drain. Probing the gallbladder digitally via Hartmanns's pouch provides tactile feedback regarding the extent of the organ when delineation visually is difficult.

In the presence of choledocholithiasis, a bile duct exploration might be required. Again, depending on the surgeon's capability and local resources this can be done laparoscopically or open. Further options are a transcystic or an open bile duct approach.

A transcystic approach, mostly used during laparoscopy, requires a dedicated operating set and intraoperative radiography.

An open bile duct exploration is achieved by exposing the anterior surface of the common bile duct by dividing the overlying peritoneum of the hepato-duodenal ligament. In planning the choledochotomy, a partially filled saline syringe can be used to confirm the CBD. The duodenum can be Kocherised to better appreciate and palpate the distal CBD.

When closing the choledochotomy, small bites in small increments is advised. A relatively small-sized dissolvable suture should be used. Non-absorbable suture is discouraged as it forms a nidus for stone formation within the CBD.

Although little evidence exists regarding the benefit of drains post cholecystectomy, they can be considered if the suspicion of a leak is high. The placements of T-tubes have gone out of fashion. It is worth noting however that newer generation T-tubes are silicone as opposed to latex. The implication is such that, current T-tubes do not elicit an inflammatory response intra-abdominally and thus precipitate a bile leak via the choledochotomy.

Cholecystectomy in severely inflamed or necrotic gallbladders can be extremely challenging. If an intraoperative bile duct injury is suspected, abandoning the procedure and referring the patient to a hepatobiliary surgeon should be seen as a testament of holistic patient care.

10.5 Complications

Serious complications that occur with cholecystectomy, including bile duct injury, bile leaks, bleeding, and bowel injury, result in part from patient selection, surgical inexperience, and the technical constraints that are inherent to the approach.

10.6 Bile Duct Injury and Leak

Biliary injury may be recognised at the time of laparoscopic surgery; if so, conversion to an open procedure and repair of the injury should be attempted only if the surgeon is comfortable with advanced biliary surgery. Otherwise, an intraoperative consult should be undertaken or consideration made for transferring the patient to a hepatobiliary (HPB) unit. External drainage of the gallbladder fossa should be

achieved prior to referral to a specialist HPB surgeon. Repair of biliary duct injuries should always be approached by an experienced multidisciplinary team.

Recognition of biliary injury may be more likely if routine intraoperative cholangiography is performed. Its value however is controversial.

Major biliary leakage is usually seen typically 7 days post cholecystectomy. Patients typically present with fever, abdominal pain, and/or bilious ascites. Jaundice is usually mild secondary to reabsorption of bile in third spaces. Leukocytosis and elevations in serum alkaline phosphatase and gamma-glutamyl transferase are common.

The bile ducts of Luschka conceptually include both small ducts that distinctly enter the gallbladder bed or small tributaries of minor intrahepatic radicals of the right hepatic ductal system. Regardless of origin, both can continue to leak after removal of the gallbladder. Clinically significant leakage from the ducts is rare.

In general, the source of the bile leak and amount of drainage determine the next course of therapy. Following radiological workup typically with a CT scan, though transabdominal US can be used, large loculated collections may need to be percutaneously or operatively drained. CT cholangiogram, Magnetic resonance cholangiopancreatography (MRCP), percutaneous transhepatic cholangiography (PTC) or hepatobiliary iminodiacetic acid (HIDA) scan can help to provide anatomical clarification of the leak. ERCP is useful as it allows CBD stent placement to control a leak.

Injuries to common bile or common hepatic ducts are the most serious and mandate an HPB unit referral and transfer.

10.7 Wound Infection

Wound infections are treated with antibiotics and open drainage where appropriate.

10.8 Bleeding

The incidence of uncontrollable bleeding from cholecystectomy can occur from three distinct sites—liver, arterial/venous sources, or port insertion sites. Bleeding from the liver bed is fairly common and is appreciated to be from the close proximity of the middle hepatic vein and its radicals to the gallbladder fossa. Bleeding usually occurs during the final aspects of the removal of the gallbladder and generally requires immediate conversion to open to control profuse haemorrhage through stitch ligation, if initial attempts at laparoscopic haemostatic control fail. Trocar site bleeds usually present subacutely and management is along a continuum that encompasses local pressure and suture to re-laparoscopy or laparotomy in those who are haemodynamically unstable.

10.9 Bowel Injury

If the injury is noted at the time of surgery, then conversion to an open procedure for repair is indicated if it cannot be repaired laparoscopically. In those that present in a delayed fashion but harbour signs of instability, peritonism, or sepsis, laparotomy and repair are indicated. In cases where the presentation is more indolent and controlled, standard enterocutaneous fistula management with nutritional support and adequate drainage and wound care is advised.

10.10 Spilled Stones

The surgeon endeavours to remove the gallbladder intact to limit spillage of stones. However, in some circumstances, gallbladder entry is inevitable. In such situations, it is prudent to identify and evacuate all spilt stones as they may form a nidus for infection and worst still contribute to post cholecystectomy syndrome.

Typically, those with spilled stones present with non-specific abdominal pain, fevers, or a discharging wound or sinus. The diagnosis is delayed owing to the lack of identification of stones radiographically in most instances. When identified, removal should be planned. It is wise to be mindful of surround friable tissue and lack of planes.

10.11 Post Cholecystectomy Syndrome (PCS)

PCS is a complex set of non-homogenous symptoms such as persistent abdominal pain and dyspepsia that recur and persist after the cholecystectomy. Diagnosis of the underlying problem causing PCS usually requires imaging. The intention is to identify retained or recurrent stones, a bile duct leak, stricture, or transection. This can be accomplished in most cases with ultrasound and/or CT scanning followed by ERCP or MRCP.

10.12 Summary

Gallstone disease in the developing nations is poorly defined. It is essential to consider the mechanics behind the stone formation with the same vigour as confronting the consequences of stone formation.

In developing countries, the delayed presentation rates are higher and thus heightened awareness of this possibility is required when multiple bouts of recurrent inflammation result in an unusually small shrunken gallbladder. In these situations, the surgeon should consider cholecystostomy or subtotal cholecystectomy.